Chemical Engineering Master's Defense

Optimum Co-Product Utilization from Hydrothermal Liquefaction of Microalgae

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abstract

Hydrothermal liquefaction (HTL) is one of the promising methods to convert wet algal biomass into biofuels. Increased biocrude yield was observed at higher operation temperatures when Galdieria sulpuraria was liquefied using water as solvent. A scale - up of the process of hydrothermal liquefaction is undertaken in both a 100 ml reactor and a 250 ml reactor to study any possible difference in quantitative productivity. There were significant changes in the product ratio of major HTL components when the reactor was scaled - up 2.5 times to a 250 ml reactor. During this study, a substantial amount of algal biomass was also converted into biochar. The biochar produced at 300 °C and 30 min of reaction time was analyzed for phosphorous content using ICP-OES and for nitrogen content using CHNS/O elemental analyzer. It was observed that 1 gram of HTL biochar has 15.98 mg of phosphorous and 5.27 mg of nitrogen. Preliminary optimization was done using biochar to study influence of temperature and pH. This proved that the leaching of phosphorous was optimum at lower pH values and higher temperatures. In the final study, macronutrients were leached using a 40 ml reactor at previously optimized temperature of 40 °C and pH 2.5 into cyanidium media prepared without initial phosphates and nitrogen in it. This method was able to extract 154.61 mg/L of reactive phosphates and 124.03 mg/L of ammoniacal nitrogen at the optimum conditions.

The phosphorous and nitrogen present in this biochar can be used to cultivate microalgae. These leached phosphates and ammoniacal nitrogen were tested for the toxicity over 15 days and then used to grow GS in a 96 well plate Microplate Assay at 40 °C and 2-3 % CO_2 in an incubator and confirmed using a Tissue Culture Roller drum apparatus with 16 mm borosilicate glass tubular photo bioreactor. A better growth was observed in all cases when leached nutrients were used compared to that of regular nutrients in the growth media.

April 6, 2017; 2:00PM; ERC 490